NICE Evaluator Webinar
February 21, 2013

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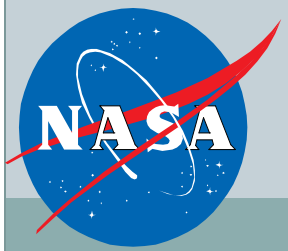

Announcements

- AEA Call for Proposals, due March 15th
- NICE Evaluation Resource Library in development
- Currently scheduling speakers for our May 2013 evaluator webinar
- PI Meeting postponed: next tri-agency climate change education in-person meeting will take place in October 2013. Series of online talks planned for Spring 2013. More information to come!
- Email ann.m.martin@nasa.gov for more on any of the above!

Agenda

- **Jan DeWaters,** Clarkson University (jdewater@clarkson.edu)
- **Kathy Comfort,** WestEd (kcomfor@wested.org)
- Discussion!

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Clarkson UNIVERSITY
defy convention ®

NYSERDA
New York State Energy Research and Development Authority

NASA
National Aeronautics and Space Administration

Design and Use of a "Climate Literacy" Survey
NICE Quarterly Evaluator Webinar
2/21/2013

Clarkson University:

Jan DeWaters

Susan E. Powers

Suresh Dhaniyala

Mary Margaret Small

Project Overview

- Create/disseminate inquiry/project-based climate change curricular modules based on NASA data and models
- Three-tiered approach for New York State audiences.
  - **College class:**
    - "Global Climate Change: Science, Engineering, and Policy" for engineering students (taught S10 semester)
  - **Teacher Workshops:**
    - Middle school STEM and high school earth and environmental science teachers from across New York
    - Develop project-based learning experiences and lessons that highlight and integrate NASA data and models (2010 and 2011)
  - **Teacher Conferences:**
    - NYSERDA-sponsored state-wide Climate Change Conference for Teachers (2012)
    - Regional workshops, and one-day workshops

Specific Project Objectives

- Improve ***climate literacy*** among college students, prepare them for NASA's workforce

- Enhance teacher ***content knowledge and skills*** development, especially related to use of NASA earth observing system data and models

- Improve ***climate literacy*** among NYS secondary students, improve STEM-related self-efficacy

Our Premise ….

Education that promotes *Climate Science Literacy* will shape students' *knowledge* about the causes and effects of climate change, their *awareness and recognition* of the role that humans play in these changes, and their *motivation to work* toward solutions.

Outcomes Assessment

Two fundamental aspects:

- Change in targeted content and personal competencies and attitudes related to global climate change
  - Climate literacy survey
  - Self-efficacy surveys

UG Students/Teachers
HS Students
MS Students

- Effectiveness of new materials/modules
  - Evaluation of new learning experiences
  - Self-assessment following classroom delivery
  - Workshop satisfaction surveys

Wanted to measure “broader outcomes” of our intervention – not necessarily tied to the content of the curriculum but, rather, broad knowledge and understanding as well as affective and behavioral aspect.

Survey Development Methodology

1. **Define content objectives for the survey:**

Knowledge aspects

- Basic understanding of climate change
- Science of climate change
- Causes/effects/mitigation strategies

Affective aspects

- Recognize problems and human role
- "Sympathetic" to the need for addressing the issues
- Understand importance of personal decisions and actions

Behavioral aspects

- Motivation to work toward solutions
- Make thoughtful, objective decisions
- Advocate change

Measurement objectives primarily guided by content of "Essential Principles of Climate Science Literacy"[1]

U.S. Global Change Research Program (2009).Washington DC. (http://www.climate.noaa.gov/education/pdfs/ClimateLiteracy-8.5x11-March09FinalHR.pdf)

Survey Development Methodology

1. **Define content objectives for the survey:** Primarily guided by "Essential Principles of Climate Science Literacy"[3]
2. **Develop Item Pool:**

A pool of items was developed primarily by reviewing the literature to search for existing items.
Use of existing items would add validity to our survey.

NOTE: **what we found in the literature was a variety of surveys and studies that looked at "one aspect" of literacy (e.g. knowledge, affect, behavior) – but not an overall, "broad" picture.**
Also, **many of the items (particularly the knowledge/understanding items) were quite (earth science) specific and not aimed for a broad understanding.**

Develop Item Pool

Content :

Shafer, M., J.E. Thomas, N. Giuliano (2009). *Enhancing climate literacy*. Paper presented at the 18th Symposium on Education, American Meteorological Society, January 11-15, 2009, Phoenix, AZ. Instrument: Making Sense of Oklahoma's Climate; Pre-Workshop Assessment.

Keller, J.M. (2006). *Part I. Development of a concept inventory addressing students' beliefs and reasoning difficulties regarding the greenhouse effect, Part II. Distribution of chlorine measured by the Mars Odyssey Gamma Ray Spectrometer.* Ph.D. dissertation, The University of Arizona, 446 pages; AAT 3237466.

Bostrom, A., M. Granger Morgan, B. Fischoff, D. Read (1994). What do people know about global climate change? 1. Mental Models. *Risk Analysis, 14(6),* 959-970. Instrument: BSRS Questionnaire, July 2009, University of Bergen, Norway.

Böhm, G., D. Hanss, A. Bostrom, B. O'Connor, and doctoral students from the Bergen Summer Research Seminar. *BSRS Questionnaire*. University of Bergen, June 2009

Mooney, M., S. Ackerman, L. Schiferl, J. Martin, T. Whittaker. (2009). *Promoting Climate Literacy through K–12 Professional Development Opportunities*. Presentation at the 18th Symposium on Education, American Meteorological Society, January 11-15, 2009, Phoenix, AZ. Survey instrument (presented at conference) was distributed at a professional development workshop in climate change.

Boyes, E., D. Chuckran, M. Stanisstreet. (1993) How do high school students perceive global climatic change: What are its manifestations? What are its origins? What corrective action can be taken? *Journal of Science Education and Technology, 2*(4):541-557.

Read, D., A. Bostrom, M. Granger Morgan, B. Fischoff, T. Smuts. (1994). What do People Know about Global Climate Change? 2. Survey Studies of Educated Laypeople. Risk Analysis 14(6):971-982.

Bord, R.J., R.E. O'Connor, A. Fisher (2000). In what sense does the public need to understand global climate change? *Public Understanding of Science*, 9:205-218.

Develop Item Pool

Affect:

Leiserowitz, A. (2007). American Opinions on Global Warming: A Yale University / Gallup / ClearVision Institute Poll. Retrieved Nov 4, 2009 from http://environment.yale.edu/news/5305.

Curry, T.E., S. Ansolabehere, H. Herzon (2007). A Survey of Public Attitudes towards Climate Change and Climate Change Mitigation Technologies in the United States: Analyses of 2006 Results. Retrieved Nov 16 from http://sequestration.mit.edu/bibliography/Publication No. LFEE 2007-01 WP.

Dunlap, R.E. (1998). Lay Perceptions of Global Risk: Public Views of Global Warming in Cross-National Context. International Sociology: Journal of the International Sociological Association, 13(4):473-498.

Behavior:

Armell, K. C., K. Yan, T.N. Robinson (submitted). The Stanford Climate Change Behavior Survey (SCCBS): Assessing greenhouse gas emissions-related behaviors in Individuals and populations. *Climatic Change*.

Survey Development Methodology

1. **Define content objectives for the survey:** Primarily guided by "Essential Principles of Climate Science Literacy"[3]
2. **Develop Item Pool:** Review related surveys, quizzes and tests, match items to content objectives
3. **Pilot Testing:** Administer 2 pilot tests among college students – item pilot (105 students) to test/evaluate full item pool, second pilot (360 students) to test retained items
4. **Evaluate and revise:** Based on results of second pilot → final survey instrument for adults/college students
5. **Review by experts:** items reviewed by HS and MS teachers
6. **Pilot Testing:** Recommended items pilot tested among 204 HS and 241 MS students Internal consistency reliability: Cronbach's $\alpha = 0.86$ (cognitive), 0.89 (affect), 0.85 (behavior)
7. **Define final surveys:** Items retained from pilot analysis formulated into final surveys for high school and middle school students

Survey Development Methodology

3. **Pilot Testing**

2 rounds of pilot tests:

(1) Full item bank administered in 2 parts to 105 Clarkson University students, spring 2010

(2) Retained items tested among 360 SUNY ESF students, fall 2010

Statistical/conceptual evaluation of items included:

- ✓ ***inter-item correlation coefficient/discrimination index***
- ✓ ***overall contribution to internal consistency reliability (Cronbach's α)***
- ✓ ***level of difficulty (cognitive items)***
- ✓ ***mean score response (affective, behavioral)***

Survey Development Methodology

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5. **Review by experts:** items reviewed by HS and MS teachers

Adult/college student survey:

Cognitive

- ✓ 42 items
- ✓ 5-option multiple choice
- ✓ 5-option agree/ disagree range

α = 0.80

Affective

- ✓ 16 items
- ✓ 5-point Likert-type scale
- ✓ 5 self-efficacy items embedded in affective subscale

α = 0.90

Behavioral

- ✓ 13 items
- ✓ 5-point Likert-type scale

α = 0.84

Survey Development Methodology

6. Pilot Testing

- ✓ Preliminary survey based on teacher input (all affective and behavioral items; 24 cognitive items) administered to 204 HS and 241 MS students, spring 2011.
- ✓ Item analysis similar to previous pilots

7. Define final surveys for HS, MS

Secondary (HS/MS) Student Survey:

Cognitive

- ✓ 21 items (HS)
- ✓ 19 items (MS)
- ✓ 5-option multiple choice
- ✓ 5-option agree/ disagree range

α = 0.68

Affective

- ✓ 14 items
- ✓ 5-point Likert-type scale
- ✓ 5 self-efficacy items embedded in affective subscale

α = 0.84

Behavioral

- ✓ 9 items
- ✓ 5-point Likert-type scale

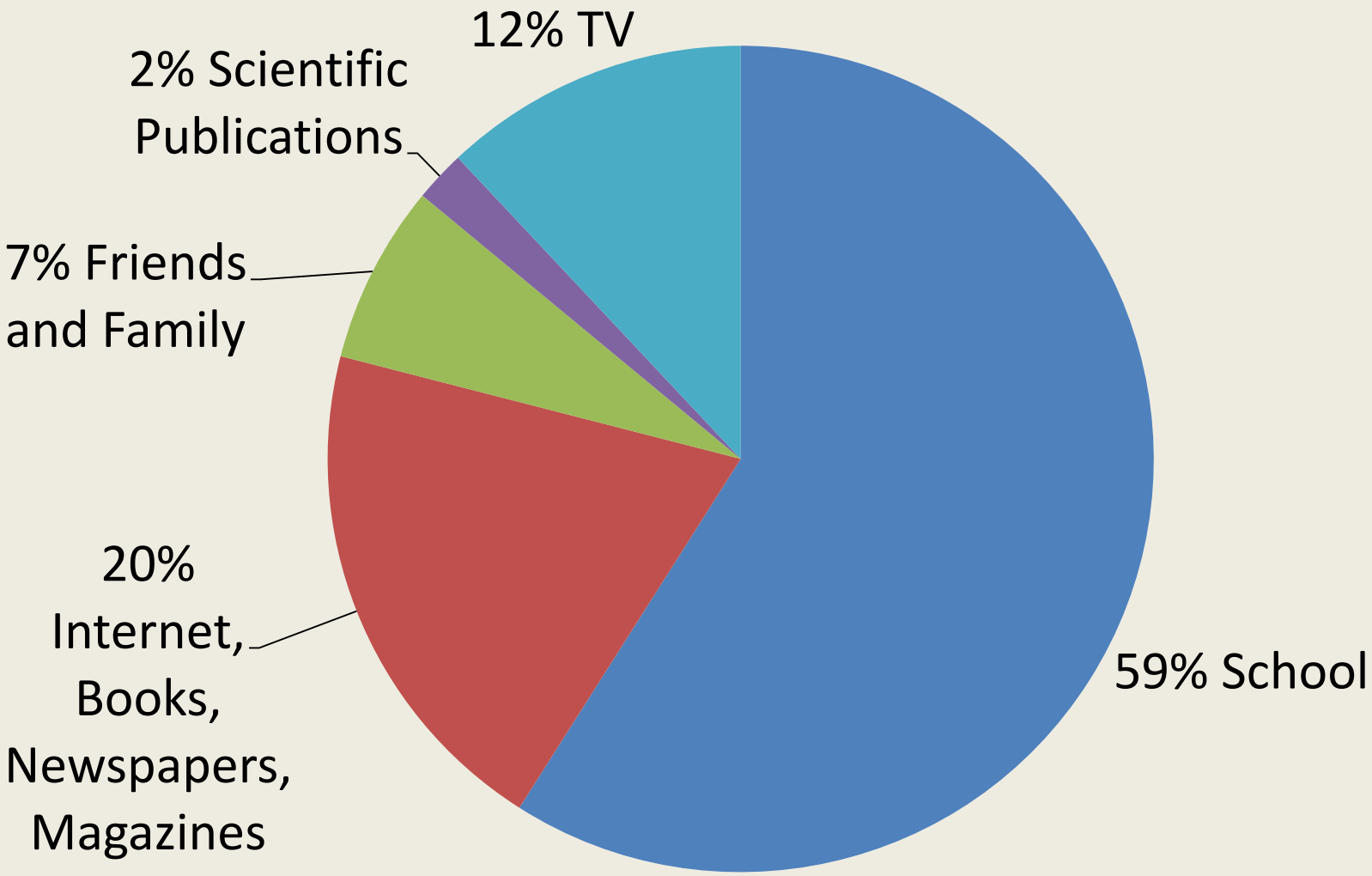
α = 0.81

Does it work?

- Climate literacy survey administered before and after
  - Undergraduate Climate Change Education Course
  - Teacher Institutes
  - Their implementation of lessons in (MS/HS) classrooms

Example results – HS Level
N=200 matched pre/post surveys

Where do students learn most about Global Climate Change?



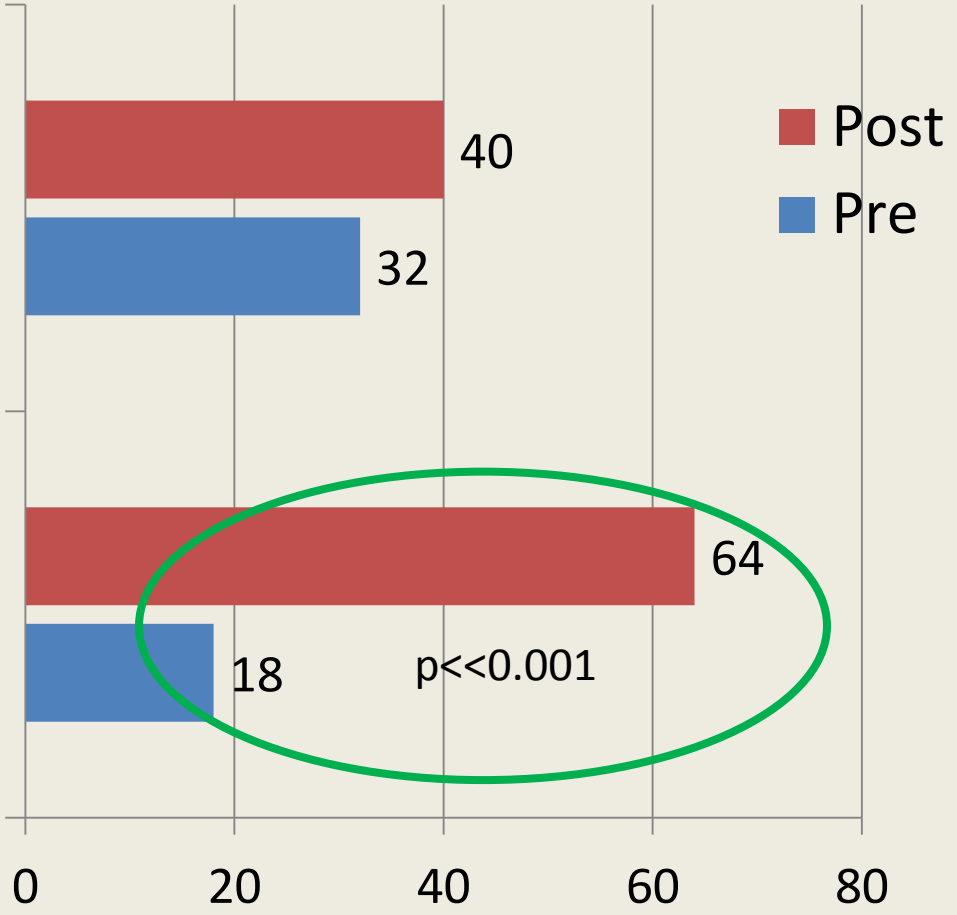
Changes in students' Self-Assessed Knowledge and Behaviors

When it comes to energy use, how would you describe yourself?

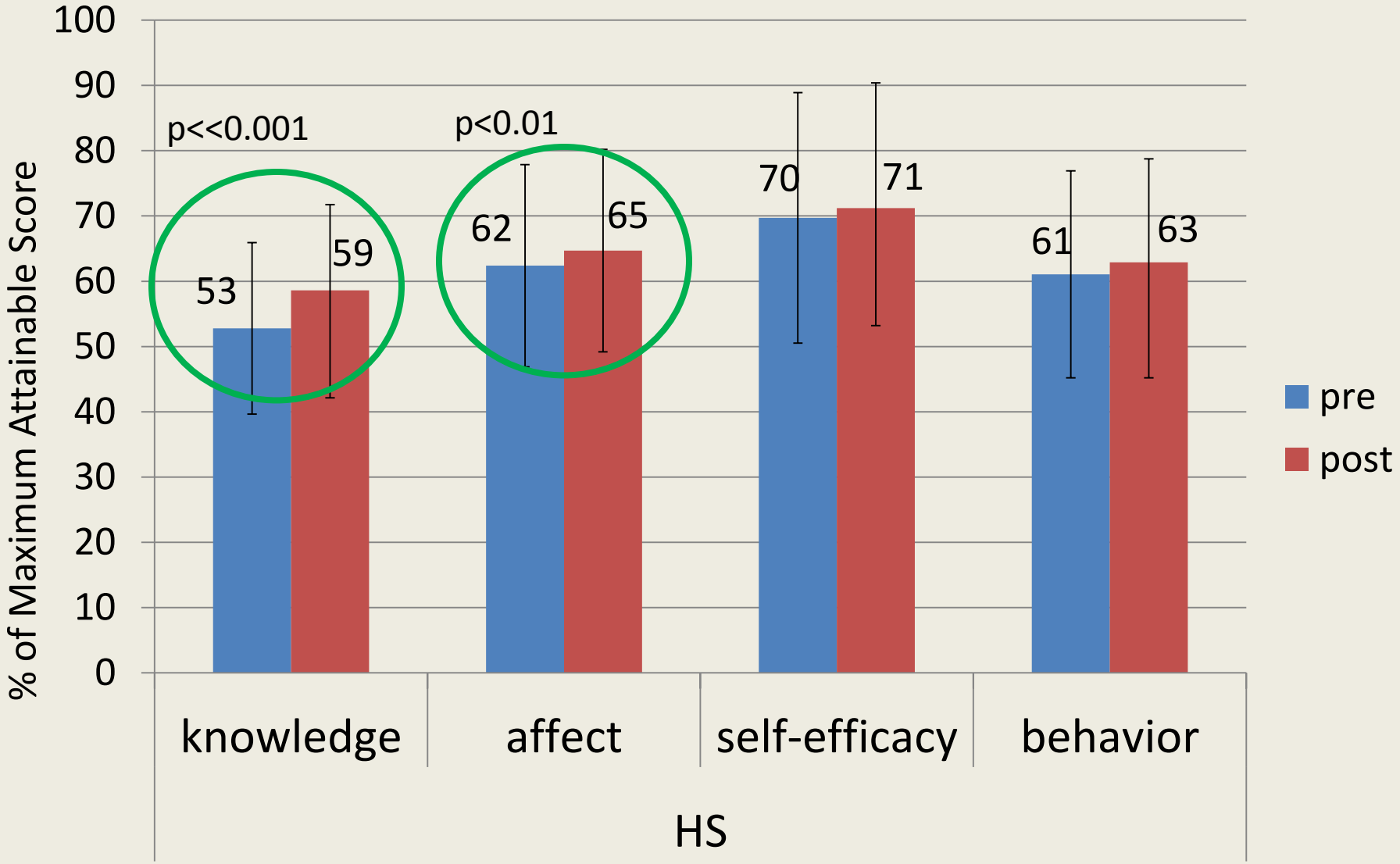
% responding "I (almost always/ sometimes) try to save energy"

How much do you feel you know about global climate change?

% responding "a lot" or "quite a bit"



Overall Changes in Climate Literacy



Cognitive Gains – significant increase in understanding of …

	% correct Pre	% correct Post
the difference between weather and climate*	70%	78%
the relationship between greenhouse effect and global warming***	20%	44%
CO_2 identified as greenhouse gas of most concern regarding global warming**	66%	78%
greenhouse gases warm atmosphere by absorbing energy at certain wavelengths**	10%	19%
Infrared identified as wavelength that is absorbed by atmosphere to cause warming***	15%	39%

*** $p<0.05$**
**** $p<0.01$**
***** $p<0.001$**

Key findings in student affect

	% responding Pre	Post
Completely/mostly convinced that global warming is happening**	74%	79%
GCC poses urgent/very serious threat to people in other countries** (compare to 38/41% for U.S.)	41%	50%
SE: Strongly/somewhat agree "I can take actions that will help reduce global warming"**	68%	70%

** $p<0.01$

Also noteworthy …

- 58/56% (pre/post) believe GCC caused mostly by humans; 25/27% believe caused equally by humans and natural causes
- 65%/70% (pre/post) believe GCC will have serious impacts within their lifetime
- 62% strongly/somewhat favor increasing costs of new cars to improve fuel efficiency, yet only 23% favor increasing taxes on gasoline to encourage people to conserve

Thank you!

Contact information:

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http://www.clarkson.edu/highschool/climate_ed/index.html

This Research Generously Funded by NASA

A Framework for Evaluation of Climate Science Professional Development Projects

A NICE NASA EXAMPLE:
PEL—Promoting Educational Leadership in Climate Science

NICE: Evaluator Webinar
February 21, 2013

Kathy Comfort, WestEd
(kcomfor@wested.org)

Bob Bleicher, CSU Channel Islands
(bob.bleicher@csuci.edu)

Purpose:

- Present overall logic model for a 3 year NASA funded project on teacher PD
- Share insights on how the logic model helps to open up and maintain communication between project staff and evaluator

A logic model is a visual graphic that:

Shows where you are going:

- What you will accomplish

How you will get there:

- A series of “if-then” relationships that, if implemented as intended, lead to the desired outcomes

Evidence that you have arrived:

- Program evaluation

Four Benefits of a Logic Model

1. Focuses on what matters – **Outcomes**

1. Provides common language – **Communication**

1. Makes explicit - **Assumptions**

1. Supports continuous - **Improvement**

Logic Models are Based on Assumptions

The **beliefs, principles, ideas** we have about the **project** (the problem or existing solution; external environment; standards; district mandates)

The **people involved** (Teachers, students, and schools: how they teach, what they learn, how they act, their motivations)

The way **we think** the project will operate (Expected outcomes and benefits)

Assumptions are Explicit Because They…

- **Underlie** what we do in the project

- **Make our thinking visible—**to promote and support ongoing **communication** between research team and project staff

If not made explicit—assumptions can **hinder** the success of the project—if the line of communication is not opened up and maintained

Logic Models Start with a Problem or Situation

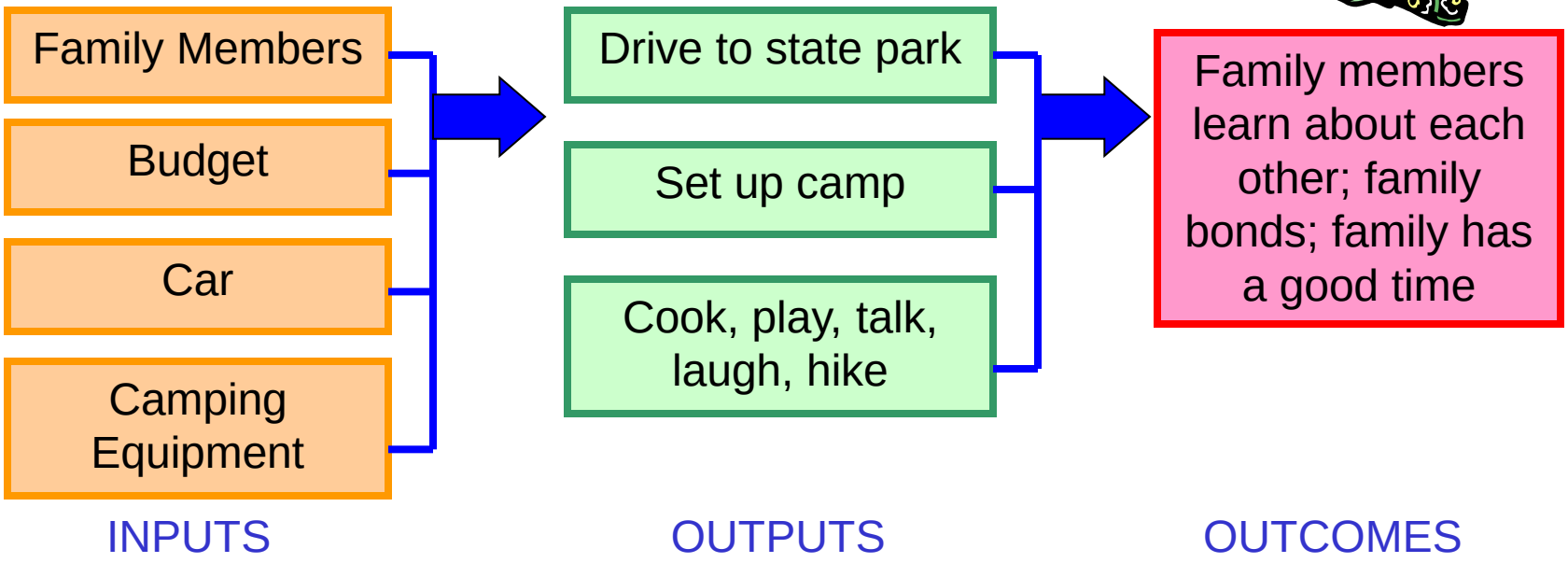
- Many teachers do not have opportunities/access to
  - Improve their knowledge and understanding of climate science—making it difficult to provide quality instruction for their students
  - Current/quality resources for teaching climate science concepts

- We want to do something that will **improve the current state of affairs**

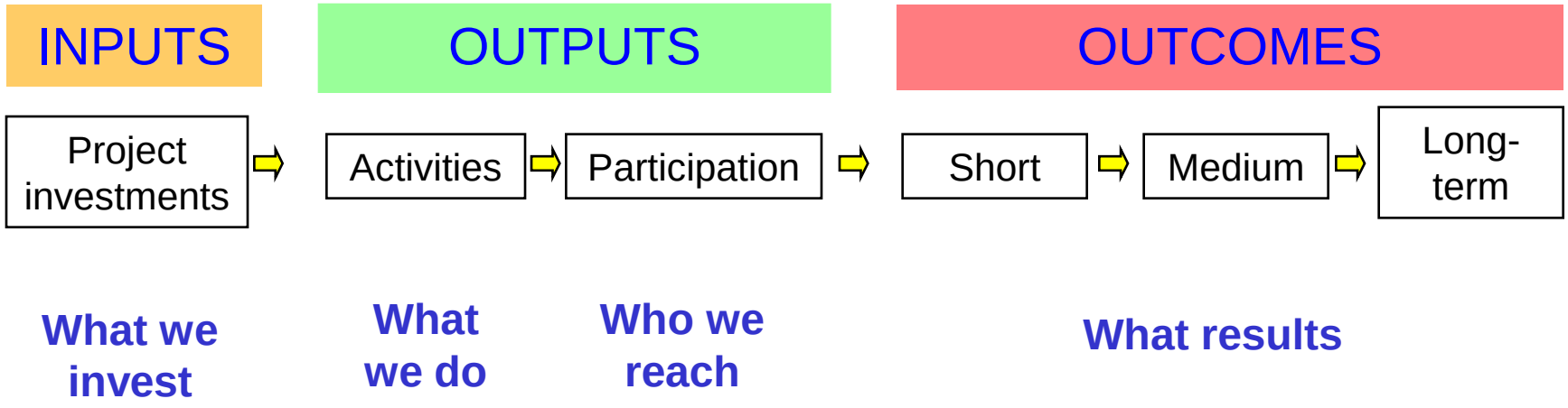
Logic Models involve a mental process—showing the series of connections and logical linkages expected to result in achieving a goal.

Problem: We are all busy and need a break

Solution: Family Vacation

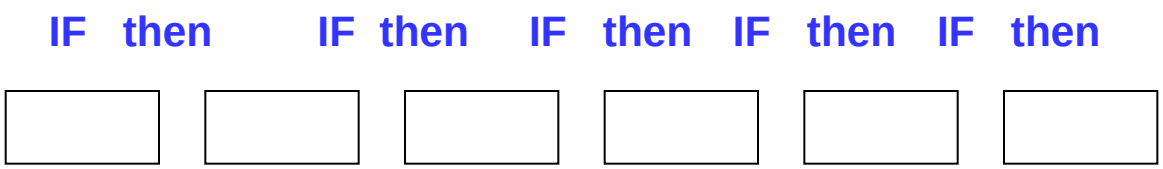


Logic Model—logical **chain of connections** showing what the project is to accomplish



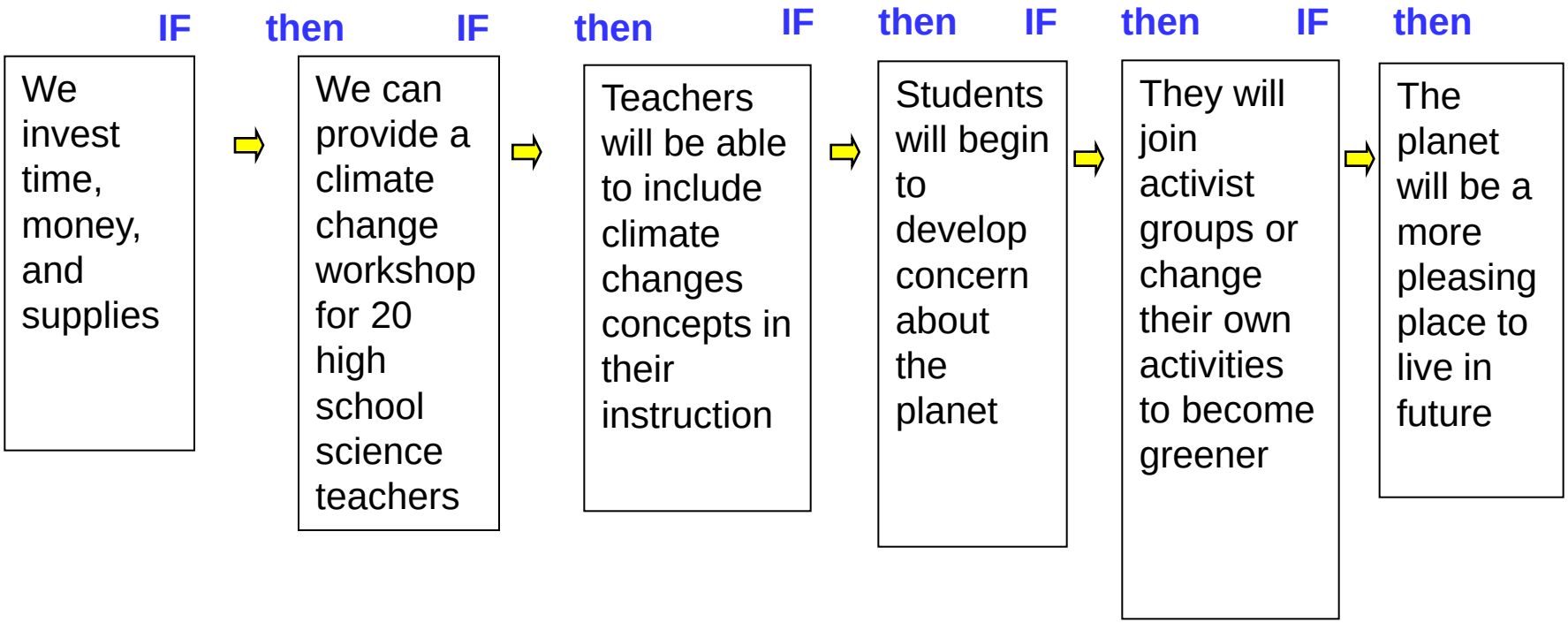
If-then relationships

Underlying a logic model is a series of 'if-then' relationships that express the project's **theory of change**



How will activities lead to desired outcomes? Through a series of if-then relationships

Climate Change Curriculum for School Instruction



PEL—Promoting Educational Leadership in Climate Science

- Leverages three NASA NICE projects with local HS district—including:
  - PD for teachers
  - Learning opportunities for students
  - Parental involvement & interaction with NASA scientists

- Increase climate science literacy in HS students through scientific argumentation using authentic NASA data.

PEL Research

1. What do we know about students' alternative conceptions about climate science and what is challenging for students?

2. Are students developing climate science literacy, especially in the difficult concept areas, after PEL implementation?

3. How effective is PEL in nurturing scientific argumentation skills based on evidence?

4. How effective are the resources we are providing in PEL?

5. Is there evidence that teachers are establishing stronger leadership capacity in their schools?

Instruments: Teacher & Student Surveys, Teacher & Student Measures, Interviews, Video, Focus Groups

Theoretical Framework for PEL Evaluation

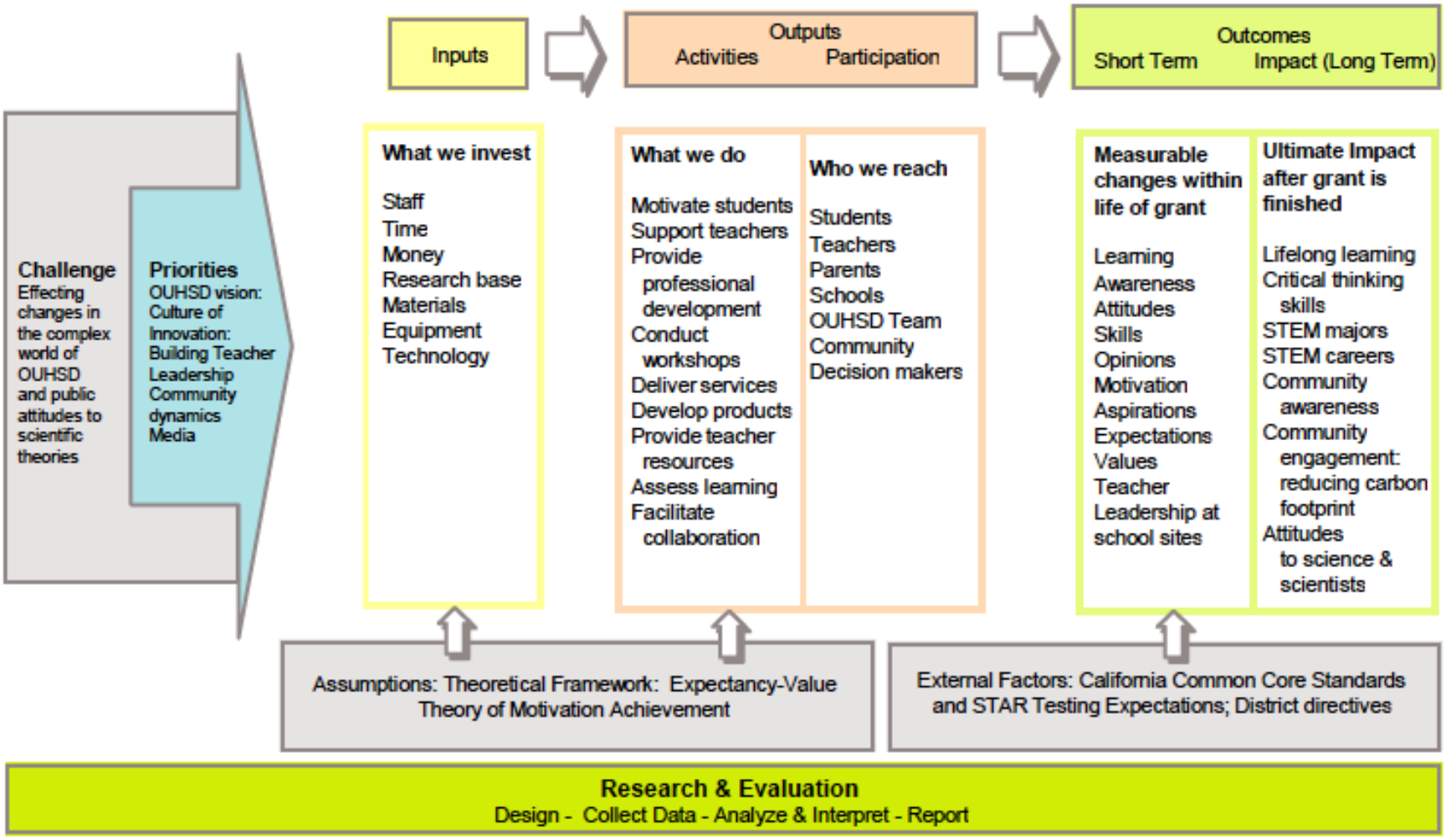
The expectancy-value theory of achievement motivation (E-V-C) (Fan, 2011; Wigfield & Eccles, 1994) provides a theoretical foundation for PEL's research.

Expectancy - the degree to which a teacher or student has reason to expect that they will be successful in school.

Value - indicates whether they think that performance at school will be worthwhile to them.

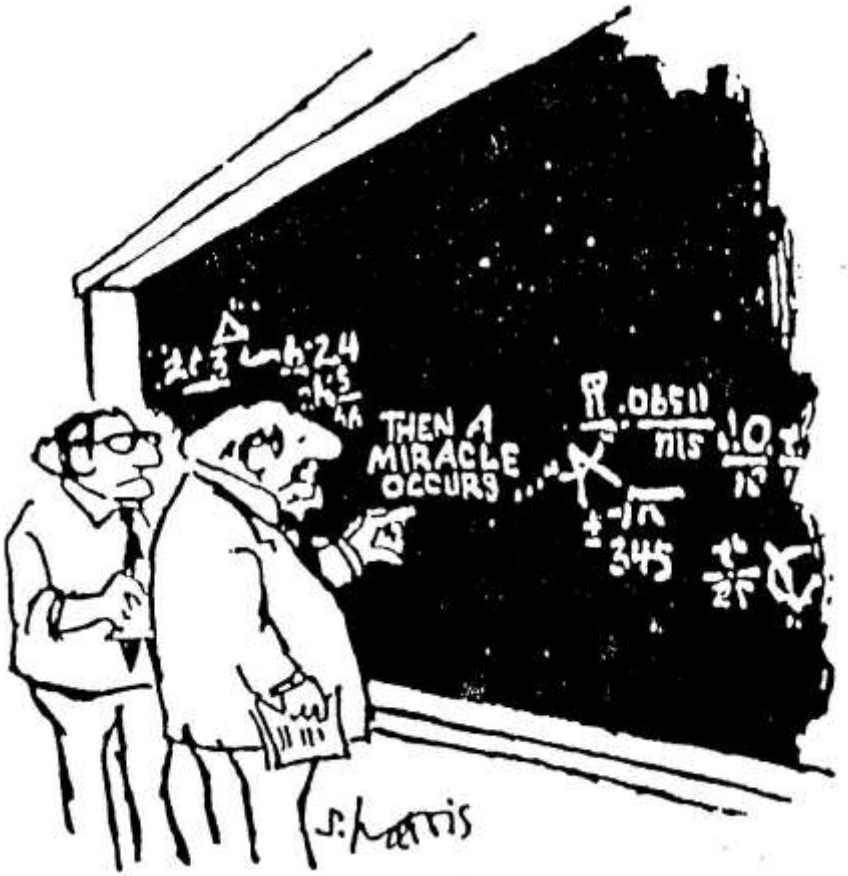
Cost - the perceived factors that can inhibit a successful performance at school.

PEL – Logic Model



A logic model **makes the connections EXPLICIT**.

"***I think you should be more explicit here in Step Two.***"



Thanks to our speakers, Jan and Kathy!

- Discussion/ Q&A!